**Ability *Pedagogical Content Knowledge* Prospective Teacher in Creating Independent Curriculum Teaching Modules**

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| Keywords | **Abstract** |
| independent curriculum, pck, prospective teachers, teachsuffing module | The presence of a teacher is one of the important factors that support the success of learning activities. Therefore, prospective teacher students need to be trained in Pedagogical Content Knowledge (PCK) skills in order to plan classroom learning effectively through the use of teaching modules. This study aimed to determine the PCK ability of chemistry education students to make teaching modules in microteaching courses. The type of research used is quantitative with descriptive methods. The research subjects were chemistry education students of class 2020 FKIP UNTAN, totaling twenty-four participants. The instruments used were teaching module assessment sheets and student PCK observation sheets. The data collection techniques used were observation and interviews. The results showed that the PCK ability of chemical education students in making teaching modules was in the good category, with an average value of content knowledge (CK) ability of 79% (good), pedagogical knowledge (PK) ability of 72% (good), and pedagogical content knowledge (PCK) ability of 78% (good). Furthermore, with the independent curriculum being implemented as a national curriculum, PCK must be prepared for the development of independent curriculum teaching modules before teaching practice at school.  https://licensebuttons.net/l/by-sa/3.0/88x31.pngThis is an open-access article under the[CC–BY-SA](http://creativecommons.org/licenses/by-sa/4.0/)license. |
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**Introduction**

The 21st century is a period where knowledge becomes highly crucial, and the era of globalization demands higher-order thinking skills. The developments in the 21st century should be accompanied by the progress of students' skills. Improving students' 21st century skills is influenced by teachers (Hampson et al., 2011). Students are required to adapt to various changes and challenges in the era of globalization by developing 21st-century skills (Hairida et al., 2021). The implementation of 21st-century learning involves four essential aspects: critical thinking and problem-solving skills, creativity and innovation, communication, and collaboration. Therefore, teachers, as a highly influential component of education, play a vital professional role in the learning process to achieve these educational goals (Makhrus et al., 2019).

Teacher is a professional in the field of education who is responsible for educating, teaching, providing guidance, directing, training, evaluating, and assessing students in various educational pathways, including early childhood education, primary education, and secondary education (Ministry of State, 2017). The teaching profession requires special competencies and abilities that other professions do not have (Darling-Hammond & Bransford, 2005). One of the important competencies for carrying out teaching duties for a teacher is pedagogical content knowledge (Shulman, 1987).

According to Loughran et al. (2006) PCK is a term that describes an academic concept that has the potential to attract interest in learning something. According to Abbitt (2011), PCK is an understanding of pedagogy, learning practices, lesson planning, and effective methods for teaching material. PCK is a combination of content knowledge and important pedagogical knowledge aimed at turning difficult material into something easier for students to understand. Therefore, teachers and prospective teachers need to understand PCK, because it involves knowledge about students' initial understanding, delivery of material, learning strategies, as well as curriculum and learning focus.

One of the factors that influences the success of the teaching and learning process in the classroom is teacher readiness (Dewi & Krismawati, 2018). Meanwhile, the important pedagogical competencies that a teacher must have are: planning ability (Yuswono et al., 2014; Febrina et al., 2016). In managing teaching and learning activities in the classroom, the competency profile in preparing the learning implementation plan plays an important role. As a result, when building learning activities in the classroom, teachers must have PCK knowledge and skills so that the topic to be taught can be conveyed pedagogically and easily understood by students (Shulman, 1987).

Good proficiency in pedagogical content knowledge (PCK), both for teachers and prospective teacher candidates, is evident from their ability to develop lesson plans (RPP) and teaching modules for the independent curriculum. However, the phenomenon in the field indicates that prospective chemistry teachers still have low proficiency in developing lesson plans (RPP) in terms of knowledge. (Istiqomah et al., 2018). Furthermore, teachers also find it challenging to develop teaching materials, including lesson plans (RPP) (Susena et al., 2016; Ernawati & Safitri, 2017; Nurhaliza, 2019). Determining methods, explaining Competency Standards/Core Competencies (SK/KI), and selecting the appropriate method to be planned in the learning design are common challenges faced. (Anugrahana, 2019). Incompatibility in determining these various components has an impact on the non-optimization of the learning process. Therefore, it is important to pay attention to good competence in preparing lesson plans or teaching modules, because this is an important indicator of pedagogical competence. Pedagogical competence is defined as the ability to manage student learning activities, including understanding and actualizing their potential (Akbar & Rustaman, 2007).

The majority of graduates from the Faculty of Teacher Training and Education at Tanjungpura University aim to become teachers. Prospective teacher students are expected to have abilities and competencies that support their professionalism in preparation to become teachers. One of the courses in the curriculum that helps students prepare and practice skills in preparing learning implementation plans or teaching modules as they are now known, is micro-teaching. This is a mandatory course for students in the sixth semester before undertaking Introduction to Schooling Fields (PLP) 2 at school. It is expected that this course would enable students to effectively develop and implement chemistry curriculum in the classroom.

Based on the issues explained earlier, research is needed on the pedagogical content knowledge (PCK) abilities of prospective teacher candidates in creating teaching modules for the independent curriculum in the microteaching course. It is expected that the research results can provide an overview of the PCK abilities of prospective teacher candidates in producing teaching modules for the independent curriculum. This information can be used as an evaluation to enhance the quality of teaching in the microteaching course. Additionally, the research findings can serve as a reference for students to improve their skills in developing teaching modules for the independent curriculum.

**Method**

Research desain

This type of research is quantitative descriptive research. According to Sugiyono (2015), descriptive research aims to describe the data that has been collected without making general conclusions. This research aims to reveal the PCK abilities of prospective teacher students in creating independent curriculum teaching modules in microteaching courses. To achieve this objective, a quantitative approach is employed by collecting and analyzing numerical data (Jayusman & Shavab, 2020).

Research sample

The research sample was chemistry education students in the class of 2020 in the chemistry education study program FKIP UNTAN Pontianak. There are eleven classes with a total population of forty-eight students. However, only six classes involve students in creating independent curriculum teaching modules in microteaching courses. Therefore, the number of samples that can be used is twenty-four.

Research procedure

The instruments used consist of a teaching module assessment sheet and a student PCK observation sheet. The teaching module assessment sheet is employed to evaluate the prospective teacher candidates' PCK based on the teaching modules for the independent curriculum created through the microteaching course. Meanwhile, the student PCK observation sheet is used to confirm the students' PCK abilities in creating teaching modules through teaching practice. Both the teaching module assessment sheet and the student PCK observation sheet have been validated by an expert team comprising 1 high school chemistry teacher from SMA Negeri 8 Pontianak, 1 physics education lecturer, and 1 chemistry education lecturer from the Faculty of Teacher Training and Education (FKIP) at Tanjungpura University (UNTAN). Based on the validation results from the three validators, the teaching module assessment sheet and the student PCK observation sheet obtained scores of 0.90 and 0.88, respectively, with a very high category.

The data on students PCK abilities were obtained from the completion of the teaching module assessment sheet and the student PCK observation sheet. Both the teaching module assessment sheet and the student PCK observation sheet were evaluated based on the teaching modules created by students in the microteaching course. The number of statements assessed on both sheets was 14 each. The teaching module assessment sheet was calculated using a formula. Each statement received a maximum score of 2 and a minimum score of 0, so the maximum score a student could achieve was 100, while the minimum score was 0.

Data analysis

The results of scoring on this teaching module assessment sheet provide values that indicate the levels of CK, PK, and PCK abilities of the students, which can be calculated using the formula:

Final Score =

After obtaining the final scores, six samples were then selected based on the categories of poor, enough, and good, determined from the teaching module assessment, to confirm the level of PCK abilities by conducting observations using the student PCK observation sheet. The observation sheet used in this study has a checklist format containing statements with yes/no options. A "yes" response indicates the statement's alignment with the teaching module, while a "no" response signifies misalignment with the teaching module.

The final calculated scores from this teaching module assessment sheet are used as data for students' PCK abilities. Based on the obtained PCK scores, the PCK ability data for each student is categorized into several groups. The categorization of PCK abilities follows the classification presented by Sugiyono (2013). The following are the categories for students' PCK abilities:

**Tabel 1.** Categories of Students PCK Abilities

|  |  |
| --- | --- |
| ***PCK Percentage*** | ***Categori*** |
| 0 – 20 % | Very less |
| 21 – 40 % | Poor |
| 41 – 60 % | Enough |
| 61 – 80 % | Good |
| 81 – 100 % | Very Good |

**Results and discussion**

Results

This research was conducted to assess the pedagogical content knowledge (PCK) of prospective teachers in creating teaching modules for the independent curriculum. The results obtained from this study include pedagogical content knowledge (PCK) data, covering aspects of content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK) of chemistry education students in developing teaching modules in the microteaching course. The findings of this research are presented in the following Table 2.

**Tabel 2.** Research Findings

|  |  |  |  |
| --- | --- | --- | --- |
| ***Aspect*** | ***Sub Aspect*** | ***%*** | ***Category*** |
| *Content Knowledge* (CK) | Conceptual Knowledge of the Material | 79 | Baik |
| *Pedagogical Knowledge* (PK) | Strategy Knowledge | 72 | Baik |
|  | Knowledge of Resources/Teaching Materials |  |  |
|  | Evaluation Knowledge |  |  |
| *Pedagogical Content Knowledge* (PCK) | Suitability between Content Knowledge (CK) And Pedagogical Knowledge (PK) | 78 | Baik |

Based on the research findings, the abilities of content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK) in prospective teachers in creating teaching modules for the independent curriculum obtained percentages of 79%, 72%, and 78%, respectively. This indicates that chemistry education students, as prospective teachers, already possess a good level of pedagogical content knowledge (PCK).

Discussion

**Content Knowledge (CK) Abilities of Chemistry Education Students**

Content knowledge (CK) is the ability that encompasses knowledge of concepts, theories, and ideas in developing the knowledge that will be taught. The CK abilities measured in this research include: (1) trigger questions; (2) breadth of presented material; and (3) depth of presented material. The data on the content knowledge (CK) abilities of chemistry education students in creating teaching modules are presented in the following table:

**Tabel 3.** Recapitulation of Capabilities *Content Knowledge (CK)* Students in Making Independent Curriculum Teaching Module

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***ASPECT*** | ***SUB ASPECT*** | ***INDICATOR*** | ***%*** | ***CATEGORY*** |
| *Content Knowledge* (CK) | Pengetahuan Konsep Materi | Igniter question | 88 | Very good |
| The breadth of the material  served | 77 | Good |
| Depth of material served | 73 | Good |
| Average | | | 79 | Good |

Based on the data in Table 2, the average content knowledge (CK) ability of prospective teacher candidates is 79%, categorized as good. The students' conceptual knowledge of the material is considered good. The indicator of trigger questions obtained a score of 88% (Very good). According to the observation results, students provided trigger questions in line with what was designed in the teaching module. This indicates that students are capable of creating and implementing trigger questions to stimulate curiosity, the ability to express opinions, and initiate discussions among peers in the form of open-ended questions such as what, why, and how (Maulida, 2022).

The indicator of the breadth of the presented material scored 77% (good). Overall, students are able to select or determine learning materials effectively. Based on the observation results, students explain the learning material according to what is planned in the teaching module. The delivered material should neither be too extensive nor too little. This aligns with Aisyah et al. (2020), who state that a common problem faced by teachers is related to the learning material being either too extensive or too limited. If the material is too limited, the learning objectives may not be achieved; conversely, if it is too extensive, it may waste time and energy to cover it.

The indicator of the depth of the presented material obtained the lowest score in CK, which is 73% (good). Although the score obtained is good based on observations, students still face difficulties in providing real-life examples while presenting the material in the teaching and learning process. Therefore, efforts are needed to make the learning process engaging and to ignite students' enthusiasm for learning, enabling them to achieve the learning objectives. As expressed by Purnamasari et al. (2016), linking conceptual material with relevant examples from real life is one way to help enhance students' abilities and learning outcomes.

**Pedagogical Knowledge (PK) Abilities of Chemistry Education Students**

PK abilities involve the teaching process, including knowledge to manage the class, plan, and implement the learning process in the classroom. The PK abilities measured in this research include: (1) writing instructional models; (2) writing teaching methods; (3) writing stages of learning activities according to the model used; (4) presenting teaching material in modules; (5) using student worksheets (LKPD); (6) using instructional media; (7) writing appropriate evaluation domains; and (8) writing appropriate evaluation tools. The data on the PK abilities of chemistry education students in creating teaching modules are presented in the following table:

**Tabel 4.** Recapitulation of Capabilities *Pedagogical Knowledge (PK):* Internal Students Creating Independent Curriculum Teaching Modules

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***ASPECT*** | ***SUB ASPECT*** | ***INDICATOR*** | ***(%)*** | ***CATEGORY*** |
| *Pedagogical Knowledge* (PK) | Knowledge  Strategy | Write down the learning model | 79 | Good |
| Write down the learning method | 40 | Poor |
| Write down the stages of learning activities according to the model used | 83 | Verry Good |
| Knowledge Source and Teaching materials | Presenting teaching material in  modules | 83 | Good |
| Using Student Worksheets  (LKPD) | 60 | Enough |
| Using instructional media | 79 | Very Good |
| Knowledge Evaluation | Write appropriate evaluation domains | 79 | Good |
| Write appropriate evaluation tools | 71 | Good |
| Average | | | 72 | Good |

Based on the data in Table 3, the average PK ability of chemistry education students from eight indicators is 72% (good). In chemistry education, students have good pedagogical competence. Writing the learning model in the teaching module received a score of 79% (good). Students are able to write learning models that are appropriate to the material being taught. Based on observations, students apply the learning model according to what is designed in the teaching module. Writing learning models in teaching modules shows the ability to deliver learning material in a structured and systematic manner to achieve learning objectives (Afandi et al., 2013).

The indicator of writing teaching methods in the teaching module only obtained a score of 40% (poor). There is a discrepancy between the lesson plans outlined in the teaching module and their practical implementation. Students did not document the teaching methods used in the teaching module, whereas, based on observational results, they applied teaching methods such as group discussions. The implementation of group discussion methods is quite effective and engaging in the classroom, as it actively involves students in expressing their opinions. This is consistent with Baroroh & Ismatulloh (2022), who suggest that the use of group discussion methods in teaching can enhance students' interest, motivation, and learning outcomes.

Therefore, the indicator of writing the stages of learning activities (syntax) according to the model used in the teaching module scored 83% (very good). Students documented the stages of learning activities in accordance with the predetermined model. Based on observations, students applied the stages of learning activities as outlined in the teaching module. Describing the stages of learning activities in writing helps create a structured framework for the learning process, enabling students to follow the learning flow effectively. In this context, it is crucial for students undergoing education as prospective teachers to adapt the stages of learning activities to meet the needs of students (Tayeb, 2017).

In addition, the indicator of presenting teaching material in the module scored 83% (very good). This is because students presented teaching material comprehensively as reading material for both teachers and students, in line with the content to be conveyed to the students. This finding aligns with observational results, where students taught the material according to the plan outlined in the teaching module. However, some students were found not to include teaching material. This is because, in the preparation of teaching modules, the inclusion of reading materials for teachers and students is optional, depending on the policies within the educational unit. Educational units have the freedom to develop teaching modules according to their needs (Maulida, 2022).

The indicator of using student worksheets (LKPD) scored 60% (enough). Students are able to create student worksheets clearly and in a structured manner according to the learning objectives. However, some students were found not to include their student worksheets in the teaching module, although observational results indicate that students use student worksheets during teaching practice in the classroom. This indicates that the lesson plans created by students in the teaching module do not align with their teaching practices. This is because students feel that the student worksheets they have created do not need to be included in the teaching module. It is advisable to include Student Worksheets (LKPD) in the teaching module, as LKPD is a crucial component of the teaching module that serves as a tool to facilitate the learning process. With the inclusion of LKPD, effective interaction between teachers and students can be established, thereby improving student learning outcomes (Umbaryati, 2016).

The indicator of using instructional media scored 79% (good). Students have been able to utilize and adapt instructional media such as books, PowerPoint, quizzes, and YouTube to the context of the material being studied. These media are used as tools to support the learning process. Based on observations, students have been using media in line with the content of the teaching module they created. This indicates that students are capable of delivering engaging lessons that capture their attention, allowing them to focus on the material presented through the media used. As Nurrita (2018) states, the benefits of instructional media include enhancing students' motivation and interest in learning. The presence of instructional media stimulates students to think critically and analyze the subject matter. Additionally, a pleasant learning environment can be created through the use of instructional media.

The indicator of writing appropriate evaluation domains scored 79% (good). Students are already capable of creating assessments for cognitive, affective, and psychomotor domains. However, some students still only assess the cognitive domain. The reason for this is that students face difficulties, especially in creating rubrics for assessing affective and psychomotor domains. Suryawati et al. (2014) state that pedagogical competence (PK) is crucial to instill in prospective teacher students so that they can prepare themselves and have adequate skills to effectively manage the learning process.

The indicator of writing appropriate evaluation tools scored 71% (good). Students have been able to compose evaluation tools that encompass assessment techniques, types of tests, and the number of questions adjusted to the learning objectives and the set time limit. Based on observations, questions are provided to students not through books but through an additional application like Quizziz, ensuring that the time for answering questions is regulated according to the time before the end of the class. This is effectively done as it makes the evaluation at the end of the learning session more efficient. Evaluation is crucial because it involves the measurement and assessment of students to analyze their level of success (Dachliyani, 2020).

**Kemampuan *Pedagogical Content knowledge* (PCK) Mahasiswa Pendidikan Kimia**

Pedagogical Content Knowledge (PCK) is the ability to combine subject matter knowledge with pedagogical skills. In this study, there is one sub-aspect that will be assessed, namely the alignment between content knowledge (CK) and pedagogical knowledge (PK), which is then developed into three indicators: (1) presented strategies aligning with the material, (2) presented instructional resources aligning with the material, and (3) presented assessments aligning with the material. The data on Chemistry Education students' PCK in creating teaching modules is presented in the following table.

**Tabel 5.** Recapitulation of Capabilities: *Pedagogical Content Knowledge* (PCK) Student in Creating Independent Curriculum Teaching Modules

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***ASPECT*** | ***SUB ASPECT*** | ***INDICATOR*** | ***(%)*** | ***CATEGORY*** |
| *Pedagogical Content Knowledge* (PCK) | Alignment of CK and PK | The strategies presented are in accordance with the material | 77 | Good |
| Presenting teaching materials/ sources in accordance with the material | 79 | Good |
| Evaluation presented in accordance with the material | 77 | Good |
| Average | | | 78 | Good |

Based on the data in Table 4, Chemistry Education students' pedagogical content knowledge (PCK) in creating teaching modules for the Micro Teaching course obtained a score of 78% (good). This means that chemistry education students have the ability to combine subject matter knowledge and pedagogical skills effectively. This is indicated by the sub-aspects of strategy, instructional resources, and assessment presented in alignment with the material, scoring 77%, 79%, and 77%, respectively, all falling under the good category.

The indicator of presenting strategies in alignment with the material scored 77% (good). Students can select teaching strategies that are suitable for the material to be delivered. This is evident from well-structured learning activity stages that reflect the overall scheme of the teaching implementation. The explanations of the learning stages mostly adhere to the syntax of the selected learning model. As Nasution (2017) expressed, learning strategies involve a series of activities between teachers and students with the goal of achieving effective learning. This includes the use of sequential activities (models), methods, and instructional media, as well as effective and efficient time allocation.

The indicator of presenting instructional resources in alignment with the material scored 79% (good). Students can present instructional resources in accordance with the material, including teacher and student reading materials (teaching materials and resources), student worksheets (LKPD), and instructional media presented in the teaching module. Astari et al. (2020) state that the selection of learning resources is generally adjusted to the objectives of the lesson material. Choosing the right and relevant learning resources will have a positive impact on improving students' understanding of the learning material and helping them relate it to everyday life situations.

The indicator of presenting evaluations in alignment with the material scored 77% (good). Students have been able to determine evaluation methods that are suitable for measuring students' abilities in line with the material taught. For example, to measure the knowledge aspect, they use test formats such as multiple-choice questions. When assessing attitudes, observation is carried out on students during learning activities using an observation sheet. Meanwhile, to measure skills, an observation sheet is used when students are presenting. A fundamental skill that teachers and prospective teachers must possess is the ability to conduct learning evaluations. Therefore, teachers or prospective teachers must have good evaluation skills in the learning and assessment process (Soulisa et al., 2022).

As stated by Hairida et al. (2023), educators' understanding of TPACK, including PCK, is still not comprehensive, and its implementation in teaching has not been fully realized. Therefore, teachers and prospective teachers need guidance regarding educational competencies so that they can improve the preparation of instructional materials.

**Conclusion**

Based on the research results, it can be concluded that the pedagogical content knowledge (PCK) abilities of chemistry education students as future teachers in creating teaching modules fall into the good category. This is evident from the CK ability of 79% (good), the PK ability of 72% (good), and the PCK ability of 78% (good). The PCK abilities of chemistry education students as future teachers in terms of the alignment between CK and PK are good and need to be maintained. Therefore, considering the implementation of the independent curriculum as the national curriculum, students, as future teachers, need to prepare their PCK for the development of teaching modules for the independent curriculum before they engage in teaching practice at schools.

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